Import Substitution of Combination Wire Rope-Part II Production and Standardisation of 17 mm dia Combination Wire Rope

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The prototype combination wire rope (Cift–CWR 1) developed for deep sea trawling was further studied for improvement, optimisation of efficiency and standardisation. A series of improved prototype combination wire ropes (Cift–CWR 2 to 6) were twisted and evaluated their mechanical properties and reported in this paper with recommendations for a standard 17 mm dia combination wire rope of 6S (7C + 8 +1 Scr) + 6 Crs (6 + 1 +1 Crc) construction.

Trawls operated from middle and distant waters need not be rigged with heavy steel wire ropes, but a fibre rope is insufficient too. Combination wire rope utilising the inherent properties of both fibre and steel can be the natural selection which can be designed in a wide range to meet the requirements of the fishing industry. The use of high tensile galvanised steel wire in combination with cheap synthetics like polypropylene or hard natural fibres can be used in this field which combine a good proportion of volume weight ratio. The prototype combination wire rope (Cift — CWR 1) developed (Meenakumari & Panicker, 1988) describes the specifications for this product. The present communication is on the standardisation of a 17 mm combination wire rope recommended for use in deep sea trawls.

Materials and Methods

The construction details are similar in all respects, except for reduction of one strand in the PP cover from the original (Meenakumari & Panicker, 1988), making the standard prototype construction as 6S (7C + 8 + 1Scr) + 6Crs (6 + 1 + 1Crc). The improved combination wire rope is made of 0.8 mm dia steel wires substituting 0.71 mm dia steel wire in the prototype. Soft twisted 2.5 mm dia PP tape yarn is used as strand cover. The central core is 4 mm dia soft twisted, 3 stranded PP tape rope.

The different combination wire rope samples were prepared by giving different pitch values as 97, 103, 107, 109 and 112 mm. All the five samples and components were tested for tensile properties in the Universal Testing Machine Zwick 1484 and the data are presented.

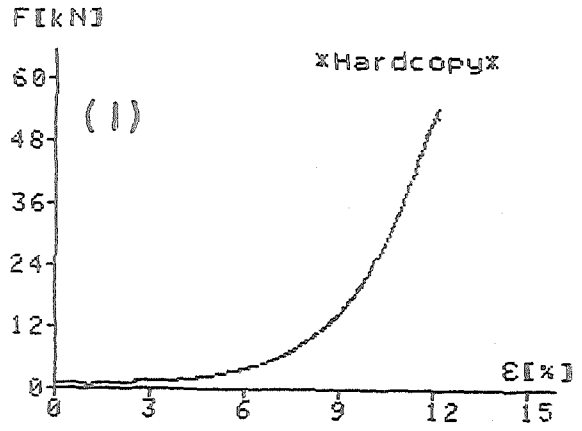
Results and Discussion

The specification of materials and tensile properties used for prototype and improved combination wire rope are given in Table 1. The 0.8 mm dia steel wire used for Cift–CWR 2 to 6 had a tensile strength of 1.2 kN/mm² (Breaking strength 0.852 kN) and 5.21% extension at break, whereas 0.71 mm dia steel wire had 1.6 kN/mm² tensile strength (0.635 kN breaking strength). The PP tape yarn 2.5 mm dia had a tensile strength 0.078 kN/mm² (0.39 kN breaking strength) and 30.6% extension at break. The previously used PP tape cover was hard twisted having a diameter of 1.6 mm with 0.169 kN/mm² tensile strength (0.34 kN breaking strength) and 26.43% extension at break. The central fibre core had 0.197 kN/mm² tensile strength (breaking strength 2.48 kN) and 22.27% extension at break.

The pitch of covered rope strands and uncovered rope strands increased by 15% whereas rope core and core strands increased between 1 and 3%. The pitch values at the rope closing stage were made 10, 13, 14.5, 17.5 and 22.5% lower than that of prototype combination wire rope. All the five samples tested for its breaking strength and the results are given in Table 2, and

Table 1. *Details of materials, specification and construction of prototype CWR I and improved prototypes*

Particulars	Prototype CWR I	Improved prototypes
Construction Specification of rope	6S (8C + 8 + 1Scr) + 6Crs (6 + 1 + 1Crc) 17.0 mm dia, 0.224 kN/mm², 11.5% extension, 125 mm pitch and 38.52 kg/100m	6S (7C + 8 + 1Scr) + 6Crs (6 + 1 + 1Crc) 17.00 mm dia, 0.29 kN/mm², 12.67% extension 112, 109, 107, 103 & 97 mm pitch 43.60 kg/100m for CWR-4
Steel wire	0.71 mm dia, 1.60 kN/mm², 4.89% extension 0.57% carbon and 0.293 kg/100m	0.80 mm dia, 1.70 kN/mm, 5.21% extension 0.72% carbon and 0.412 kg/100m
PP Twisted tape yarn cover and strand core	1.6 mm dia, 0.169 kN/mm², 26.43% extension 0.136 kg/100m. Hard twisted 8 Nos.	2.50 mm dia, 0.078 kN/mm² 30.60% extension 0.164 kg/100m. Soft twisted 7 Nos.
PP Tape central core	3.0 mm dia, 0.245 kN/mm² 38.85% extension0.425 kg/100 m, 3 stranded and twisted	4.0 mm dia, 0.197 kN/mm², 22.27% extension 0.61 kg/100 m. 3 stranded soft twisted
Rope strand covered	5.5 mm dia, 0.248 kN/mm², 4.2% extension, 41.6 mm pitch, 3.49 kg/100 km	6.00 mm dia, 0.25 kN/mm², 6.87% extension, 48.0 mm pitch 4.30 kg/100 m
Rope strand uncovered	2.25 mm dia, 1.30 kN/mm² 2.3% extension, 2.56 kg/100 m and 20.80 mm pitch	3.5 mm dia, 0.656 kN/mm² 3.79% extension, 3.20 kg/100 m, 24 mm pitch
Rope core	6.5 mm dia, 0.75 kN/mm², 3.44% extension, 13.09 kg/100 m, 50.00 mm pitch	7.00 mm dia, 0.80 kN/mm² 4.0% extension, 17.40 kg/100 m, 52 mm, pitch
Rope core strand	2.0 mm dia, 0.637 kN/mm², 2.9% extension, 2.36 kg/100 m, 21.4 mm pitch	3.2 mm dia, 0.682 kN/mm², 3.40% extension, 2.9 kg/100 m, 22.1 m pitch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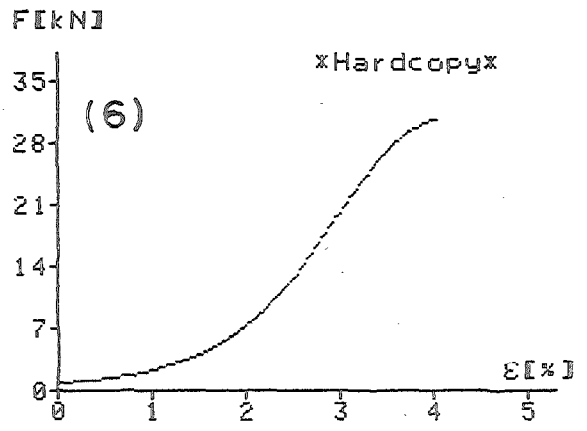
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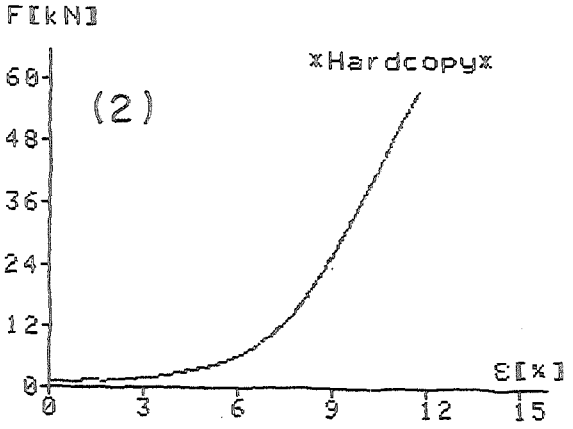
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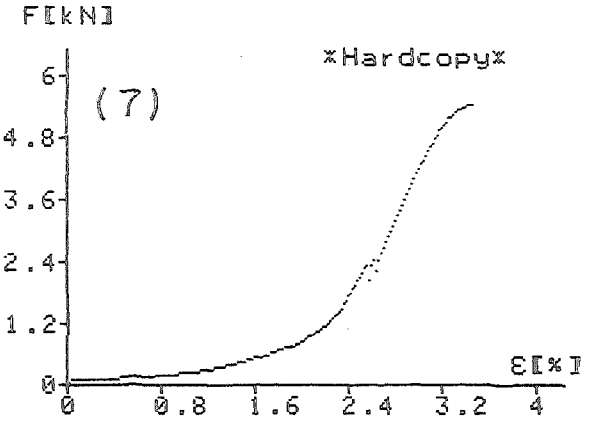
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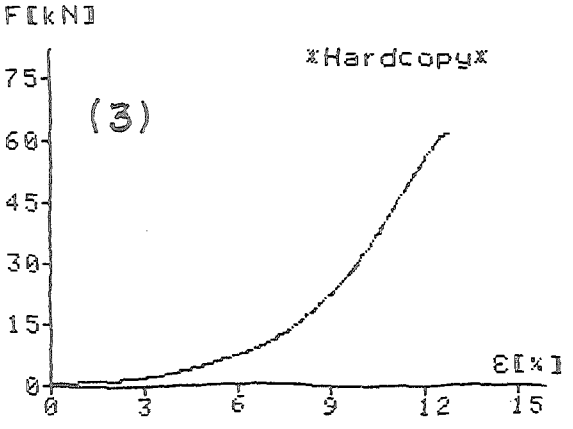
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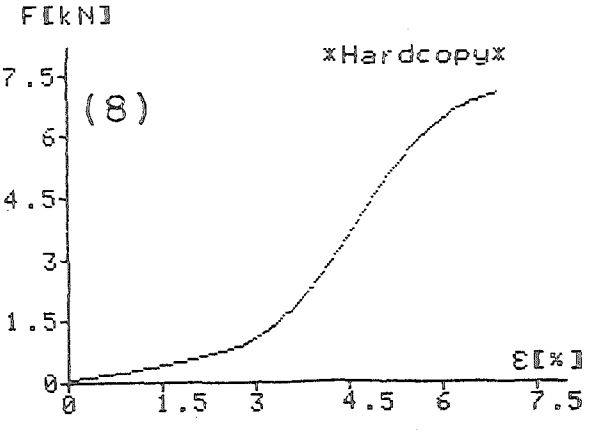
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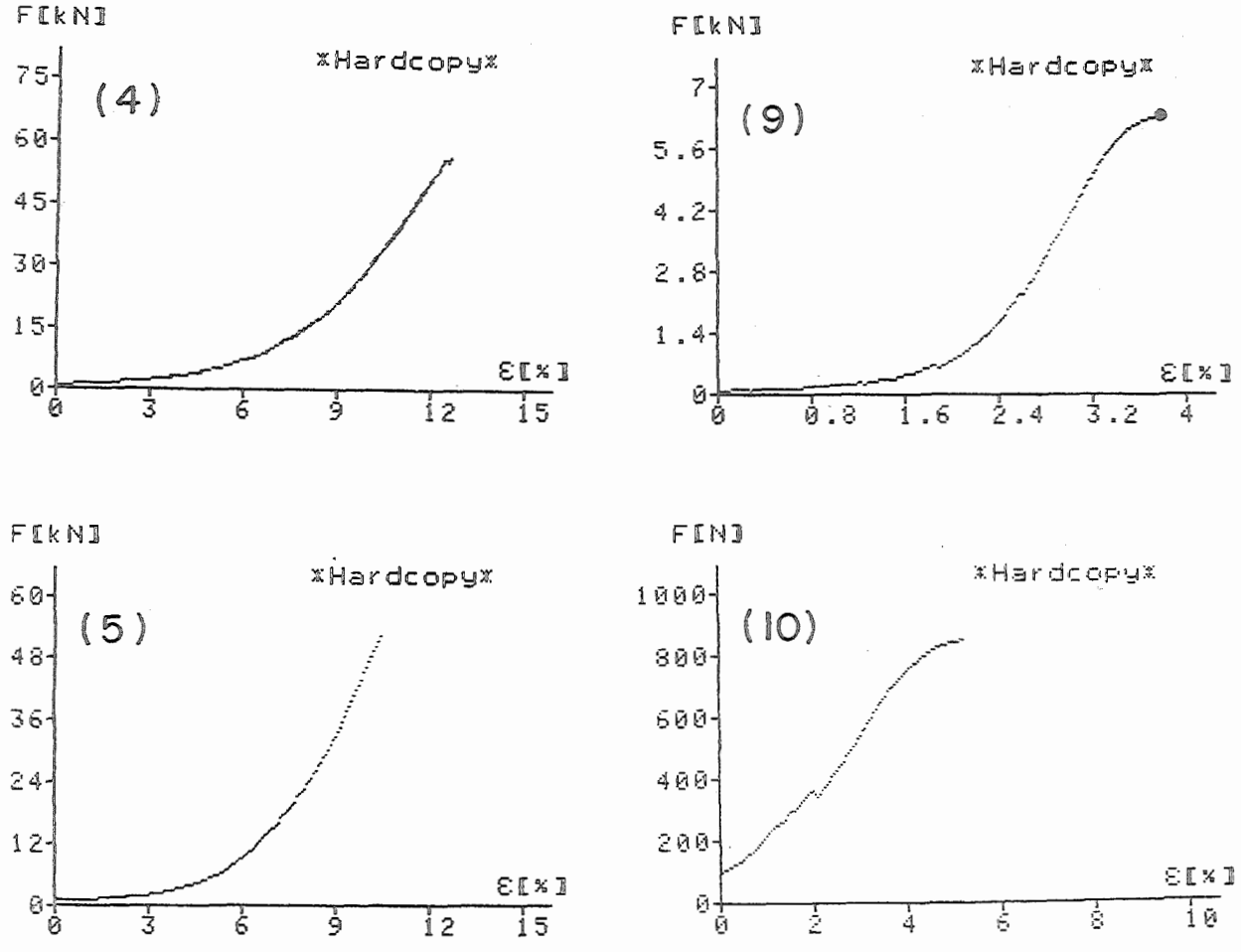

Fig. 1. Tensile properties of prototype Cift combination wire ropes 1-5) Cift CWR-2-6 6) Rope core 7) Core strand 8) PP covered rope strand 9) Rope strand uncovered 10) Single wire

Table 2. *Tensile properties of Cift CWR prototypes and components manufactured for standardisation purposes*

Details of prototype		F. Max. kN	E–B %	E–R kN	E–R %	S mm	Diameter mm	Pitch mm
Full rope		6S (7C + 1 Scr) + 6 Crs (6 + 1 + 1 Crc)						
Cift-CWR	2	55.04	12.18	54.88	12.18	226.98	17.00	112
,,	3	56.39	10.76	56.34	10.77	226.98	17.00	109
,,	4	66.15	12.67	65.76	12.71	226.98	17.00	107
,,	5	62.25	13.55	62.30	13.56	226.98	17.00	103
,,	6	56.47	12.67	56.34	12.67	226.98	17.00	97
Rope core		30.84	4.00	30.82	4.02	38.48	7.00	52
Core strand		5.49	3.46	5.49	3.46	8.04	3.20	22
Rope strand covered		7.07	6.87	7.06	6.88	28.27	6.00	48
Rope strand uncovered		6.29	3.79	6.29	3.80	9.62	3.50	24
Single wire		0.85	5.21	0.85	5.21	0.50	0.80	—
PP cover		0.39	30.21	0.39	30.21	4.90	2.50	—
PP Rope (Central core)		2.48	22.27	2.48	22.27	12.56	4.00	—

the load elongation curves presented in Fig. 1. From the data, Cift-CWR 4 was found to be best with a pitch value of 107 mm giving a breaking strength of 66.15 kN. The combination wire ropes which were prepared with pitch values lower and higher had shown lesser breaking strength, which proved the selection of the optimum pitch value as 107 mm.

The steel wire used (0.8 mm) has improved the tensile strength of the rope from 0.223 kN/mm² to 0.242 — 0.29 kN/mm². Improved soft twisted thicker PP tape yarn cover of comparatively low breaking force and high extension at break resulted in a rope of better flexibility, insultation and abrasion resistance. Reduction in the pitch values at the closing stage make the rope more stable and compact in addition to considerable increase in the breaking strength. The percentage reduction of the aggregate strength of steel wire and PP component to final rope is 30% as against 35% in the prototype, and the reduction at rope closing stage is 9% instead of 15.5% in the prototype. The pitch variation at the rope closing stage has effected a negligibly small variation of diameter within the range of −1 to + 4%, which is recommended as standard (IS: 2266, 1970).

The prototype Cift-CWR 4 with the maximum breaking strength of 66.15 kN (0.29 kN/mm²) and a maximum extension of 12.67% at break with a pitch value of 107 mm and 6S (7C + 8 + 1Scr) + 6Crs (6 + 1 + 1Crc) construction is recommended as standard combination wire rope. The admissible limit of variations are ± 5% in breaking strength and extension at break of the rope, ± 2% in the case of steel wire and ± 5% in the pitch value.

The standardisation is meant because there exists no International (Klust, 1983) or Indian standard for combination wire ropes. The standardisation of specification can judge the quality of product offered by manufacturers and dealers in terms of its use in the fishing industry.

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